Amendments to the Claims

This listing of claims will replace all prior versions, and listing, of claims in the application.

Listing of Claims:

1. (Original) A waveform equalizing device for adaptively equalizing a waveform of a Viterbi-decodable input signal pattern, comprising:

equalization means for generating an equalized signal pattern through equalization of a waveform according to the input signal pattern;

path metric difference detection means for detecting a path metric difference between a correct path and an error path in Viterbi decoding based on the equalized signal pattern;

target value setting means for setting a target value for the path metric difference; and

equalization adapting means for adapting the equalization according to an error of the detected path metric difference from the target value.

2. (Original) The waveform equalizing device as defined in claim 1, wherein:

the path metric difference detection means sequentially detects path metric differences between associated correct paths and error paths as the Viterbi decoding proceeds; and

the equalization adapting means adapts the equalization so as to minimize a mean square of errors of the detected path metric differences.

3. (Original) The waveform equalizing device as defined in claim 1, wherein:

the equalization means sequentially associates input signals forming the input signal pattern with equalization coefficients and convolves the equalization coefficients with the input signals associated with the equalization coefficients, so as to generate the equalized signal pattern; and

the equalization adapting means updates the equalization coefficients so as to minimize a square of the error which is a function of the equalization coefficients, in order to adapt the equalization.

4. (Currently Amended) The waveform equalizing device as defined in claim 3, wherein:
the equalization adapting means subtracts a gradient multiplied by a constant value from the equalization coefficients, so as to update the equalization coefficients, the gradient being a partial differentiation of the function with respect to the equalization coefficient.

5. (Currently Amended) The waveform equalizing device as defined in claim 4, wherein:
the equalization adapting means is arranged to calculate a product of the error and a sum of the input signals with predetermined weights to obtain the gradient, the input signals forming the input signal pattern giving a path corresponding to the path metric difference where the error occurs.

6. (Original) The waveform equalizing device as defined in claim 1, further comprising:
decoding means for decoding the input signal pattern to generate a decoded bit pattern; and pattern detection means for detecting, in the decoded bit pattern, one of such specific bit patterns that when an ideal waveform signal pattern for the Viterbi decoding is assumed, the path metric difference becomes equal to a pre-specified value,
wherein
when one of the specific patterns is detected, the equalization adapting means adapts the equalization according to an error of a path metric difference, from a target value, detected according to a signal pattern corresponding to the detected one of the specific patterns in the equalized signal pattern.

7. (Currently Amended) The waveform equalizing device as defined in claim 6, further comprising:

information data decoding means for Viterbi decoding the equalized signal pattern to generate an information data bit pattern used as information data,

wherein

the decoding means performs Viterbi decoding with a shorter path memory length than that in the Viterbi decoding by the information data decoding means, so as to generate the decoded bit pattern.

8. (Original) The waveform equalizing device as defined in claim 1, further comprising:

memory means for storing a predetermined reference bit pattern and for, when the memory means receives as the input signal pattern a reference signal pattern which, when decoded, should provide the reference bit pattern, outputting the reference bit pattern in synchronism with the received reference signal pattern; and

pattern detection means for detecting, in the reference bit pattern fed from the memory means, one of such specific bit patterns that when an ideal waveform signal pattern for the Viterbi decoding is assumed, the path metric difference becomes equal to a pre-specified value,

wherein

when one of the specific patterns is detected, the equalization adapting means adapts the equalization according to an error of a path metric difference, from a target value, detected according to a signal pattern corresponding to the detected one of the specific patterns in the reference signal pattern.

9. (Currently Amended) The waveform equalizing device as defined in claim 6, wherein:

the target value setting means sets the target value to the pre-specified value.

10. (Currently Amended) The waveform equalizing device as defined in claim 6, wherein:

the pre-specified value is a minimum value of the path metric difference according to the ideal waveform signal pattern.

11. (Currently Amended) The waveform equalizing device as defined in claim 6, wherein:

the pre-specified value is a number of minimum values of the path metric difference according to the ideal waveform signal pattern.

12. (Currently Amended) The waveform equalizing device as defined in claim 1, further comprising:

decoding means for decoding the input signal pattern to generate a decoded bit pattern, wherein

when the decoding means generates the decoded bit pattern corresponding to the correct path surviving in the Viterbi decoding, the target value setting means sets the target value for the path metric difference detected according to the signal pattern corresponding to the decoded pattern in the equalized signal pattern, to the path metric difference according to the ideal waveform signal pattern in a case when an ideal waveform signal pattern for the Viterbi decoding corresponding to the decoded pattern is assumed.

13. (Currently Amended) The waveform equalizing device as defined in claim 1, further comprising:

memory means for storing a predetermined reference bit pattern and for, when the memory means receives as the input signal pattern a reference signal pattern which, when decoded, should provide the reference bit pattern, outputting the reference bit pattern in synchronism with the received reference signal pattern,

wherein

when the memory means outputs the reference bit pattern, the target value setting means sets the target value for the path metric difference detected according to the signal pattern which, when decoded, should provide the reference bit pattern in the equalized signal pattern, to the path metric difference according to the ideal waveform signal pattern in a case when an ideal waveform signal pattern for the Viterbi decoding corresponding to the decoded pattern is assumed.

14. (Original) An information reproducing device, comprising:

the waveform equalizing device as defined in claim 1; and

reproduction means for reproducing the input signal pattern from an information storage medium.

15. (Original) A communications device, comprising:

the waveform equalizing device as defined in claim 1; and

receiving means for receiving the input signal pattern transmitted over a communication path.

16. (Canceled)

17. (Canceled)

18. (Original) A waveform equalizing device for adaptively equalizing a waveform of a Viterbi-decodable input signal pattern, comprising:

an FIR filter for generating an equalized signal pattern through equalization of a waveform according to the input signal pattern;

a Viterbi decoding circuit for detecting a path metric difference between a correct path and an error path in Viterbi decoding based on the equalized signal pattern;

a target value register for setting a target value for the path metric difference; and

a tap coefficients update circuit for adapting the equalization according to an error of the detected path metric difference from the target value.

19. (Original) The waveform equalizing device as defined in claim 18, wherein:

the Viterbi decoding circuit decodes the input signal pattern to generate a decoded bit pattern;

the waveform equalizing device further comprises a specific pattern detector circuit for detecting, in the decoded bit pattern, one of such specific bit patterns that when an ideal waveform signal pattern for the Viterbi decoding is assumed, the path metric difference becomes equal to a pre-specified value; and

when one of the specific patterns is detected, the tap coefficients update circuit adapts the equalization according to an error of a path metric difference, from a target value, detected according to a signal pattern corresponding to the detected one of the specific patterns in the equalized signal pattern.

20. (Currently Amended) The waveform equalizing device as defined in claim 19, wherein:

the Viterbi decoding circuit Viterbi decodes the equalized signal pattern to generate an information data bit pattern used as information data and performs Viterbi decoding with a shorter path memory length than a path memory length with which the information data bit pattern is generated, so as to generate the decoded bit pattern.

21. (Original) The waveform equalizing device as defined in claim 18, further comprising:

a reference bit pattern memory for storing a predetermined reference bit pattern and for, when the reference bit pattern memory receives as the input signal pattern a reference signal

pattern which, when decoded, should provide the reference bit pattern, outputting the reference bit pattern in synchronism with the received reference signal pattern; and

a specific patterns detector circuit for detecting, in the reference bit pattern fed from the reference bit pattern memory, one of such specific bit patterns that when an ideal waveform signal pattern for the Viterbi decoding is assumed, the path metric difference becomes equal to a pre-specified value,

wherein

when one of the specific patterns is detected, the tap coefficients update circuit adapts the equalization according to an error of a path metric difference, from a target value, detected according to a signal pattern corresponding to the detected one of the specific patterns in the reference signal pattern.

22. (Original) The waveform equalizing device as defined in claim 18, wherein:

the Viterbi decoding circuit decodes the input signal pattern to generate a decoded bit pattern;

wherein

when the Viterbi decoding circuit generates the decoded bit pattern corresponding to the correct path surviving in the Viterbi decoding, the target value register sets the target value for the path metric difference detected according to the signal pattern corresponding to the decoded pattern in the equalized signal pattern, to the path metric difference according to the ideal waveform signal pattern in a case when an ideal waveform signal pattern for the Viterbi decoding corresponding to the decoded pattern is assumed.

23. (Currently Amended) The waveform equalizing device as defined in claim 18, further comprising:

a reference bit pattern memory for storing a predetermined reference bit pattern and for, when the reference bit pattern memory receives as the input signal pattern a reference signal

pattern which, when decoded, should provide the reference bit pattern, outputting the reference

bit pattern in synchronism with the received reference signal pattern,

wherein

when the reference bit pattern memory outputs the reference bit pattern, the target value

register sets the target value for the path metric difference detected according to the signal pattern

which, when decoded, should provide the reference bit pattern in the equalized signal pattern, to

the path metric difference according to the ideal waveform signal pattern in a case when an ideal

waveform signal pattern for the Viterbi decoding corresponding to the decoded pattern is

assumed.

24. (Original) An information reproducing device, comprising:

the waveform equalizing device as defined in claim 18; and

an optical pickup for reproducing the input signal pattern from an information storage

medium.

25. (Original) A communications device, comprising:

the waveform equalizing device as defined in claim 18; and

receiver for receiving the input signal pattern transmitted over a communication path.

26. (Original) A waveform equalization method of adaptively equalizing a waveform of

a Viterbi-decodable input signal pattern, comprising the steps of:

(a) generating an equalized signal pattern through equalization of a waveform according

to the input signal pattern;

(b) detecting a path metric difference between a correct path and an error path in Viterbi

decoding based on the equalized signal pattern; and

(c) adapting the equalization according to an error of the detected path metric difference

from a target value for the path metric difference.

27. (Original) The waveform equalization method as defined in claim 26, wherein:

step (b) is recursively carried out so as to sequentially detect path metric differences between associated correct paths and error paths as the Viterbi decoding proceeds; and

step (c) adapts the equalization so as to mInImIze a mean square of errors of the detected path metric differences.

28. (Original) The waveform equalization method as defined in claim 26, wherein:

step (a) sequentially associates input signals forming the input signal pattern with equalization coefficients and convolves the equalization coefficients with the input signals associated with the equalization coefficients, so as to generate the equalized signal pattern; and

step (c) updates the equalization coefficients so as to minimize a square of the error which is a function of the equalization coefficients, in order to adapt the equalization.

29. (Original) A signal quality evaluation device for evaluating quality of a Viterbi-decodable digital signal, comprising:

specific patterns detection means for detecting one of specific patterns in a bit pattern corresponding to the digital signal; and

computing means for, when the specific patterns detection means detects one of the specific patterns, computing a path metric difference between a correct path dictated by the detected one of the specific patterns and an error path which fails to survive the correct path in Viterbi decoding, according to the digital signal, using equations each predetermined for a different one of the specific patterns.

30. (Currently Amended) The signal quality evaluation device as defined in claim 29, further comprising:

evaluation means for evaluating the quality according to a result of computation by the computing means.

31. (Currently Amended) The signal quality evaluation device as defined in claim 29, further comprising:

bit pattern generating means for comparing the digital signal with a threshold value for binarization of the digital signal, so as to generate the bit pattern.

32. (Currently Amended) The signal quality evaluation device as defined in claim 29, wherein:

the detected specific pattern indicates a minimum number of state transitions occurring before the error path merges with the correct path.

33. (Currently Amended) The signal quality evaluation device as defined in claim 29, wherein:

the equations are predetermined in accordance with partial response properties of the Viterbi decoding and switchable in accordance with the detected specific pattern.

34. (Original) A reproducing device, comprising:

the signal quality evaluation device as defined in claim 29;

Viterbi decoding means for Viterbi decoding a digital signal; and

control means for controlling the quality of the digital signal according to an output from the signal quality evaluation device.

35. (Canceled)

36. (Canceled)

37. (Original) A signal quality evaluation device for evaluating quality of a Viterbi-decodable digital signal, comprising:

a specific patterns detector circuit for detecting one of specific patterns in a bit pattern corresponding to the digital signal; and

a computing circuit for, when the specific patterns detector circuit detects one of the specific patterns, computing a path metric difference between a correct path dictated by the detected one of the specific patterns and an error path which fails to survive the correct path in Viterbi decoding, according to the digital signal, using equations each predetermined for a different one of the specific patterns.

38. (Currently Amended) The signal quality evaluation device as defined in claim 37, further comprising:

an evaluation circuit for evaluating the quality according to a result of computation by the computing circuit.

39. (Currently Amended) The signal quality evaluation device as defined in claim 37, further comprising:

a bits decoding circuit for comparing the digital signal with a threshold value for binarization of the digital signal, so as to generate the bit pattern.

40. (Original) A signal quality evaluation method of evaluating quality of a Viterbi-decodable digital signal, comprising the steps of:

(a) detecting one of specific patterns in a bit pattern corresponding to the digital signal; and

(b) when step (a) detects one of the specific patterns, computing a path metric difference between a correct path dictated by the detected one of the specific patterns and an error path

which fails to survive the correct path in Viterbi decoding, according to the digital signal, using equations each predetermined for a different one of the specific patterns.

41. (New) A waveform equalization program for execution on a computer of a waveform equalizing device so as to control operation of the waveform equalizing device, said program including instructions, criteria and code segments to:

generate an equalized signal pattern through equalization of a waveform according to the input signal pattern;

detect a path metric difference between a correct path and an error path in Viterbi decoding based on the equalized signal pattern;

set a target value for the path metric difference; and

adapt the equalization according to an error of the detected path metric difference from the target value.

42. (New) A computer-readable storage medium on which is stored a waveform equalization program, said program including instructions, criteria and code segments to:

generate an equalized signal pattern through equalization of a waveform according to the input signal pattern;

detect a path metric difference between a correct path and an error path in Viterbi decoding based on the equalized signal pattern;

set a target value for the path metric difference; and

adapt the equalization according to an error of the detected path metric difference from the target value.

43. (New) A signal quality evaluation program for execution on a computer of a signal quality evaluation device for controlling operation of said signal quality evaluation device, said program including instructions, criteria and code segments to:

detect one of specific patterns in a bit pattern corresponding to the digital signal; and

when the specific patterns detection means detects one of the specific patterns, compute a path metric difference between a correct path dictated by the detected one of the specific patterns and an error path which fails to survive the correct path in Viterbi decoding, according to the digital signal, using equations each predetermined for a different one of the specific patterns.

44. (New) A computer-readable storage medium on which is stored a signal quality evaluation program, said program including instructions, criteria and code segments to:

detect one of specific patterns in a bit pattern corresponding to the digital signal; and

when the specific patterns detection means detects one of the specific patterns, compute a path metric difference between a correct path dictated by the detected one of the specific patterns and an error path which fails to survive the correct path in Viterbi decoding, according to the digital signal, using equations each predetermined for a different one of the specific patterns.